
Vitamins

Vitamins

1. Water-soluble Vitamins
2. Fat-soluble Vitamins

1. Water-soluble Vitamins

- Vitamin B_1 (Thiamin)
- Vitamin B_2 (Riboflavin)
- Vitamin B_3 (Niacin)
- Vitamin B_5 (Panthotenic acid)
- Vitamin B_6 (Pyridoxine)
- Vitamin H (Biotin)
- Vitamin B_9 (Folic acid)
- Vitamin B_{12} (Cobalamin)
- Vitamin C (Ascorbic acid)

Water-Soluble Vitamins

Water-soluble vitamins are:

- **Soluble in aqueous solutions.**
- **Used as cofactors by many enzymes.**
- **Not stored in the body.**

Table 21.9 Vitamins and Function

Water-Soluble Vitamins	Coenzyme	Function
Thiamine (vitamin B_1)	Thiamine pyrophosphate	Decarboxylation
Riboflavin (vitamin B_2)	Flavin adenine dinucleotide (FAD); Flavin mononucleotide (FMN)	Electron transfer
Niacin (vitamin B_3)	Nicotinamide adenine dinucleotide (NAD^+); Nicotinamide adenine dinucleotide phosphate ($NADP^+$)	Oxidation–reduction
Pantothenic acid (vitamin B_5)	Coenzyme A	Acetyl group transfer
Pyridoxine (vitamin B_6)	Pyridoxal phosphate	Transamination
Cobalamin (vitamin B_{12})	Methylcobalamin	Methyl group transfer
Ascorbic acid (vitamin C)	Vitamin C	Collagen synthesis, healing of wounds
Biotin	Biocytin	Carboxylation
Folic acid	Tetrahydrofolate	Methyl group transfer

2. Fat-soluble Vitamins

- Vitamin A (Retinol)
- Vitamin D
- Vitamin E (Tocopherol)
- Vitamin K
- Lipoic acid (Thioctic acid)

Fat-Soluble Vitamins

Fat-soluble vitamins:

- Are A, D, E, and K.
- Soluble in lipids, but not in aqueous solutions.
- Important in vision, bone formation, antioxidants, and blood clotting.
- Stored in the body.

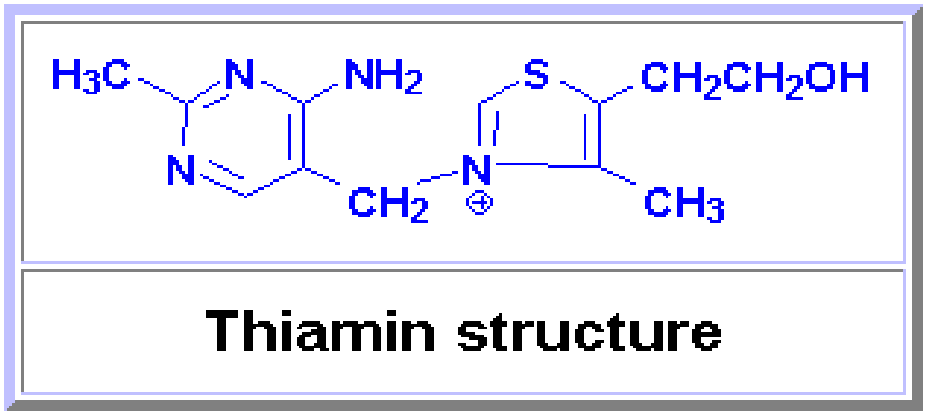
Fat-Soluble Vitamins

Vitamin A	Formation of visual pigments; development of epithelial cells
Vitamin D	Absorption of calcium and phosphate; deposition of calcium and phosphate in bone
Vitamin E	Antioxidant; prevents oxidation of vitamin A and unsaturated fatty acids
Vitamin K	Synthesis of prothrombin for blood clotting

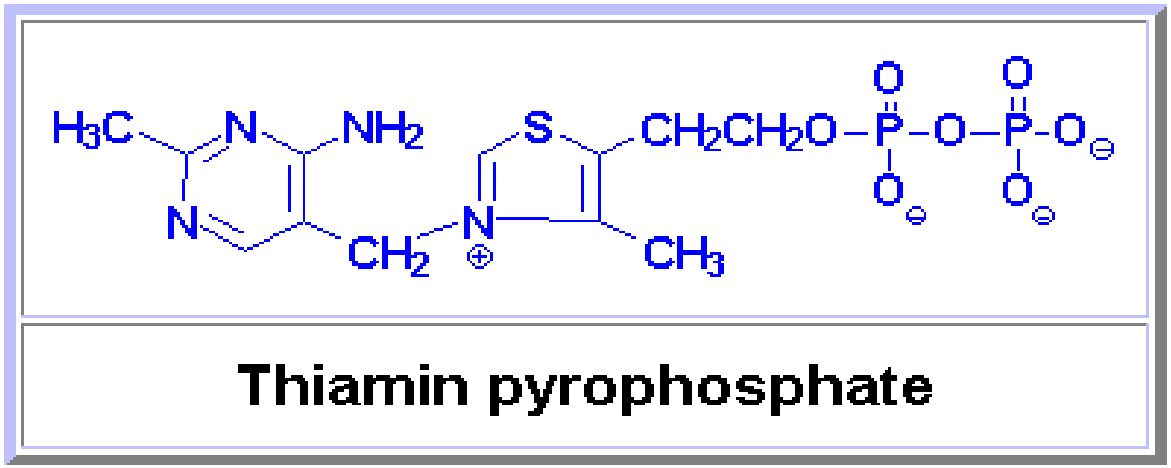

Water-soluble Vitamins

Vitamine B_1 (Thiamin)

Thiamin



Thiamin structure

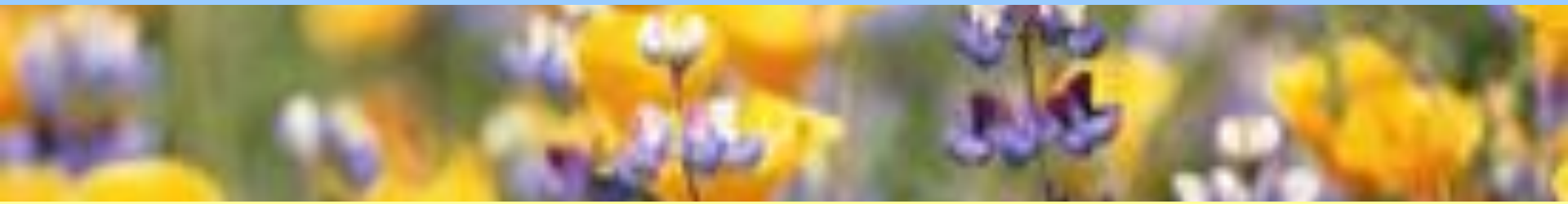


Thiamin pyrophosphate

TPP is necessary as a cofactor for:

- **Pyruvate dehydrogenase**
- **α-ketoglutarate dehydrogenase**
- **Transketolase catalyzed reactions of PPP.**
- **A deficiency in thiamin intake leads to a severely reduced capacity of cells to generate energy as a result of its role in these reactions.**

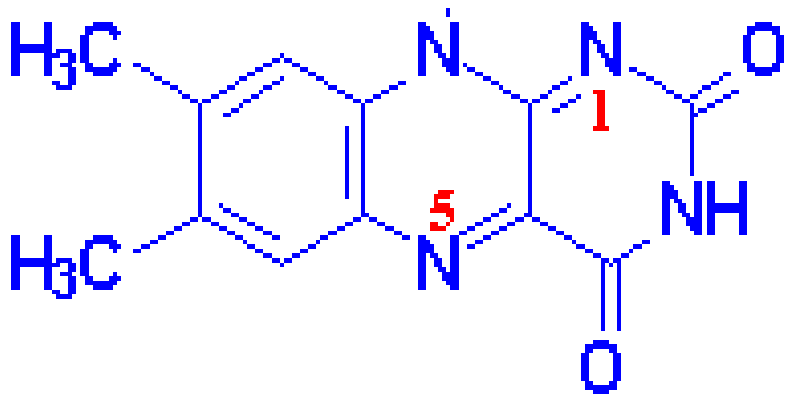
Clinical Significances of Thiamin Deficiency



- **Beriberi, is the result of a diet that is carbohydrate rich and thiamin deficient.**

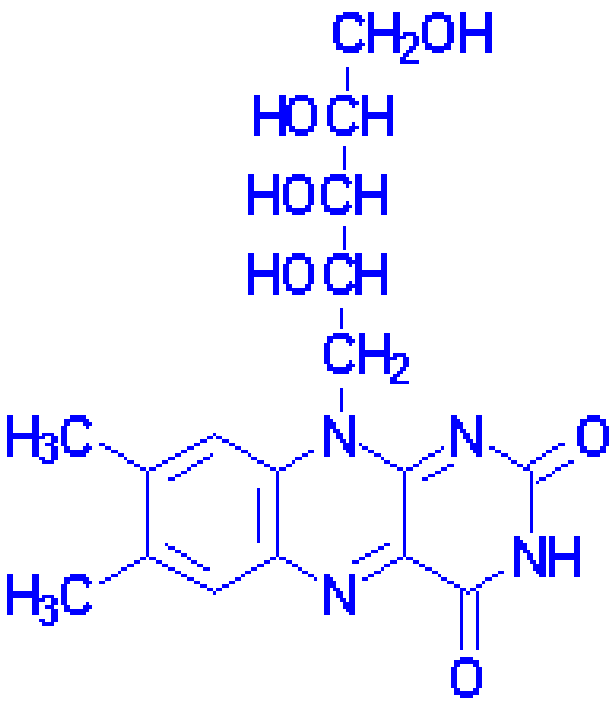
- **Wernicke-Korsakoff syndrome. This disease is most commonly found in chronic alcoholics due to their poor dietetic lifestyles.**

Vitamine B_2



Structure of Flavin

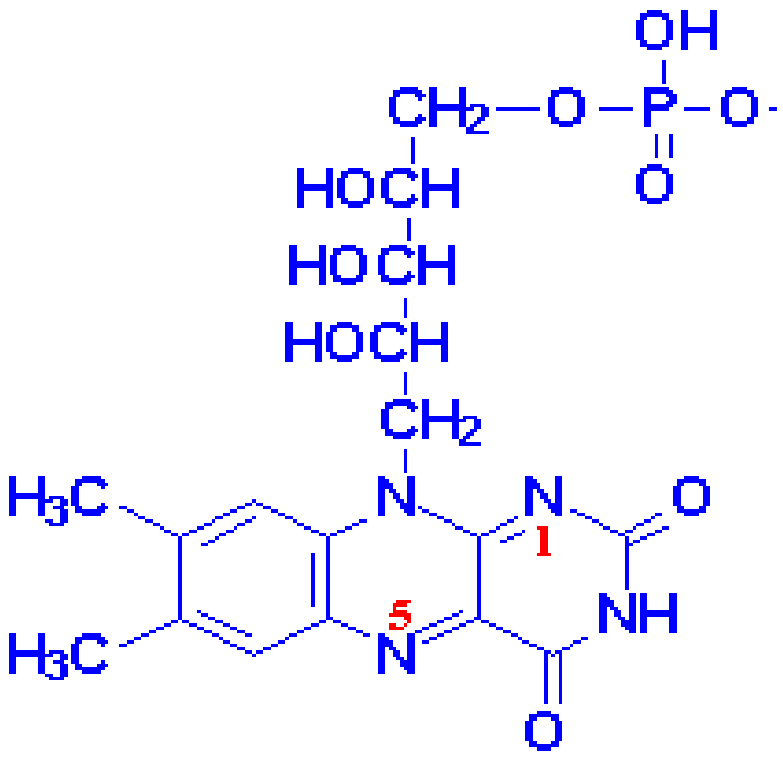
Vitamine B_2



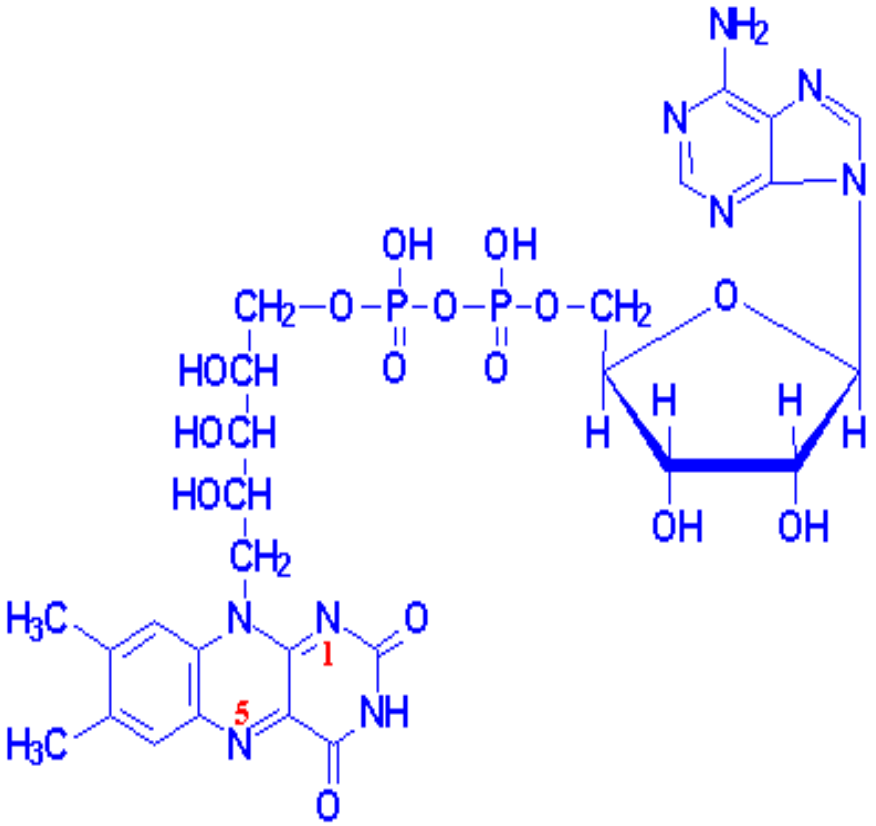
Riboflavin structure

vitamin B_2

Vitamine B_2



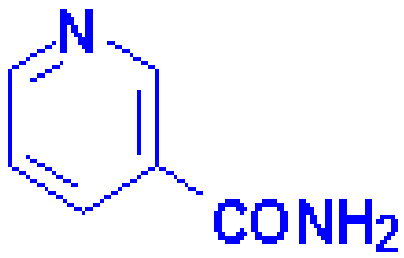
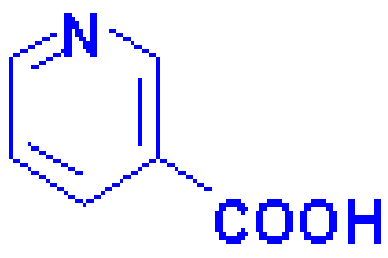
Structure of FMN



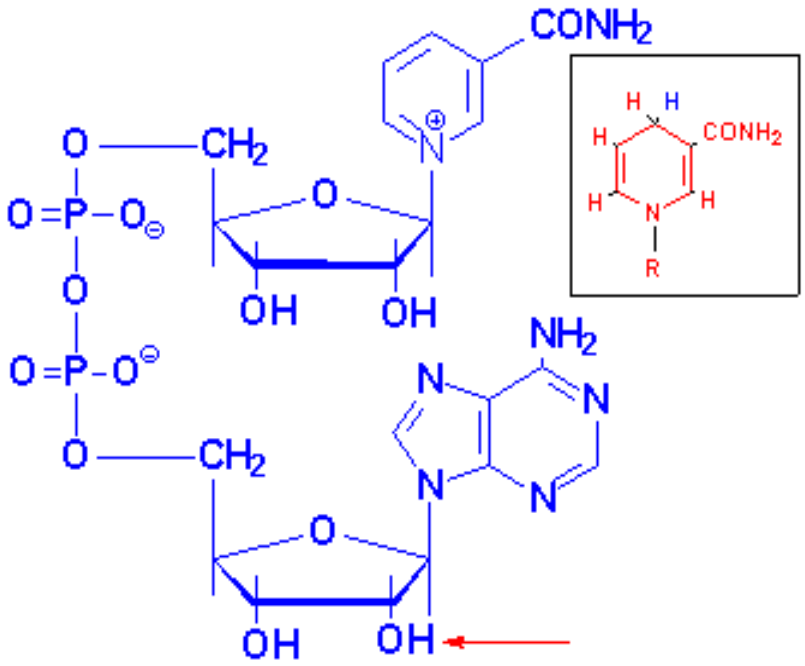
Structure of FAD

Vitamine B_3

Niacin

	
Nicotinamide	Nicotinic Acid

Vitamine B_3

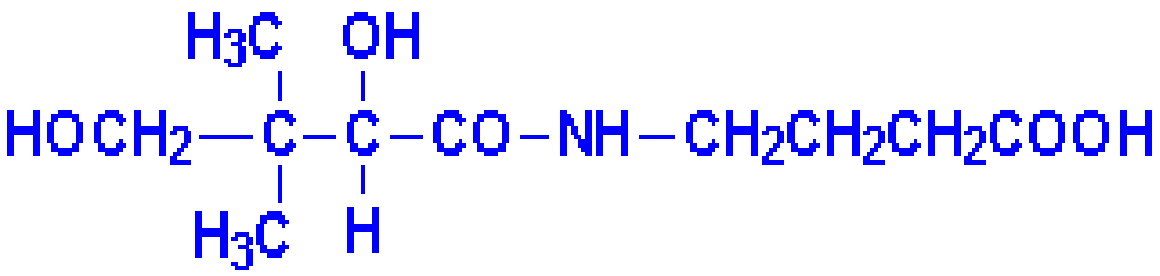


Structure of NAD$^+$

NADH is shown in the box insert.

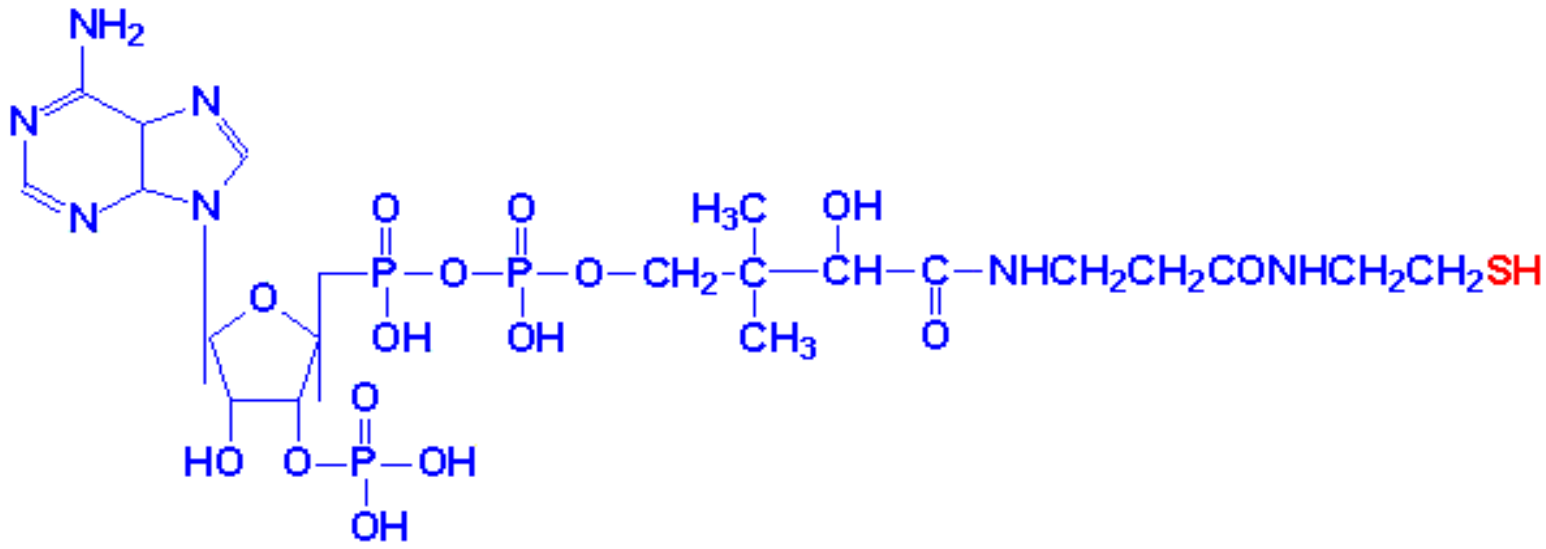
The -OH phosphorylated in **NADP$^+$** is indicated by the red arrow.

Vitamin B_5



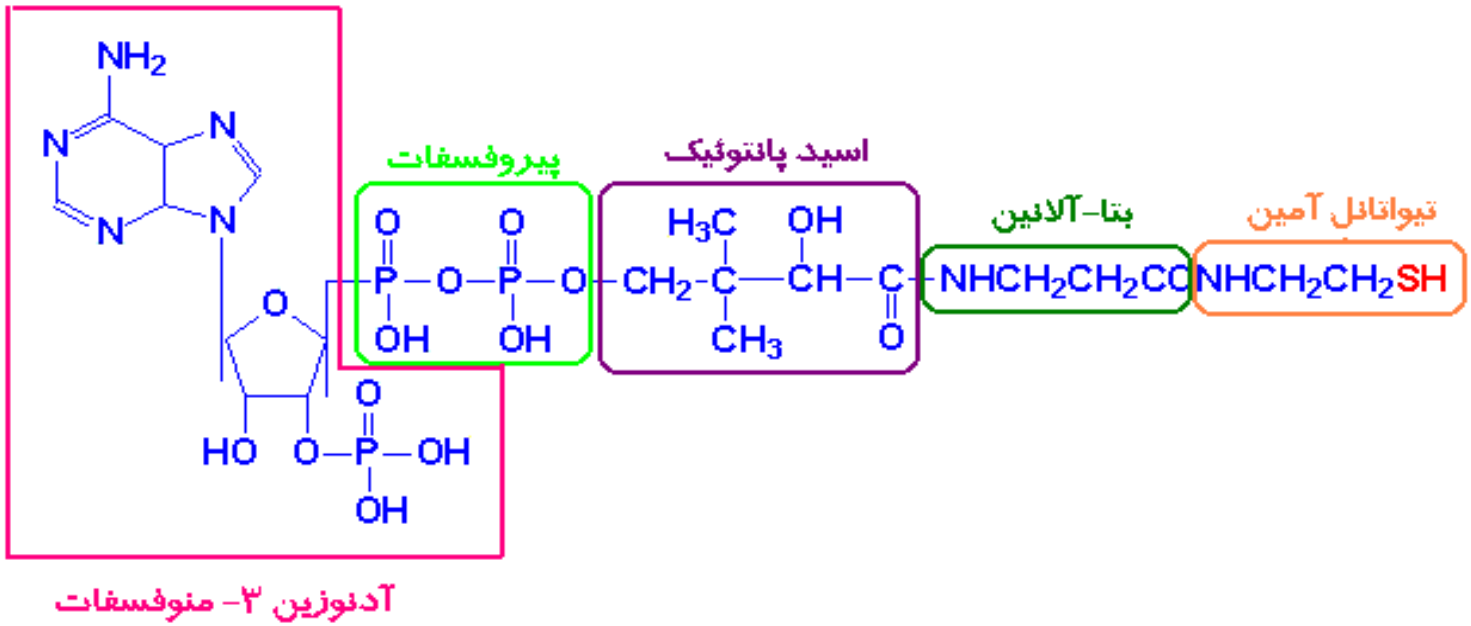
Pantothenic Acid

Vitamine B_5



Coenzyme A

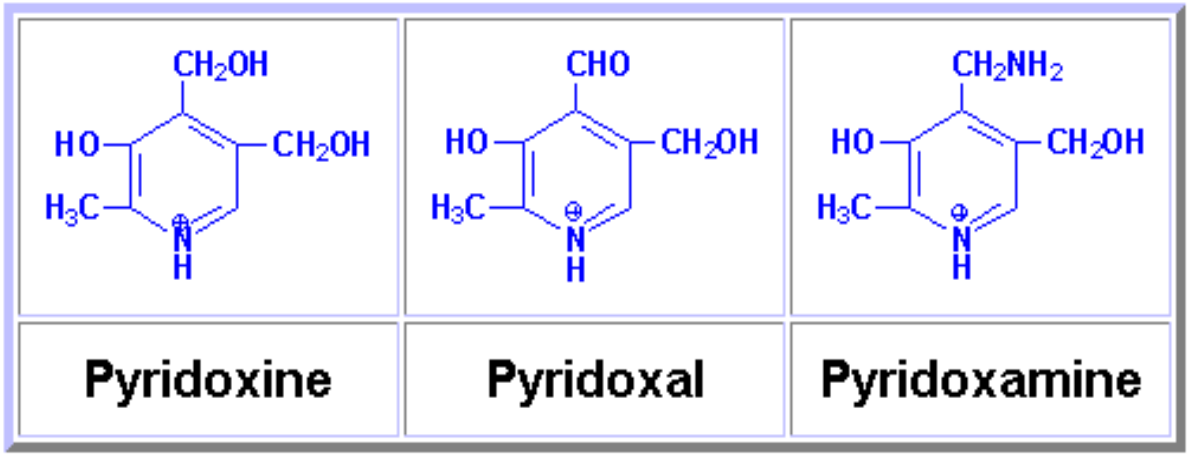
Vitamine B_5



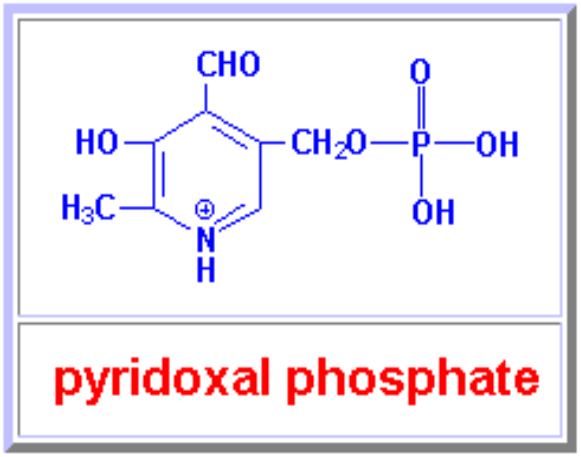
Coenzyme A

Vitamine B_6

Vitamin B_6



Pyridoxine	Pyridoxal	Pyridoxamine

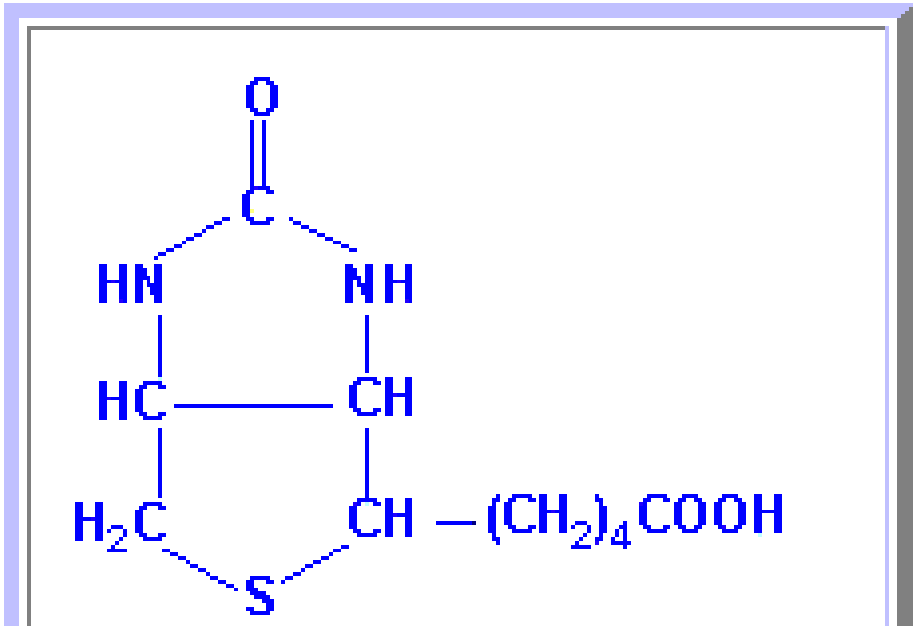


pyridoxal phosphate

Vitamine B_6

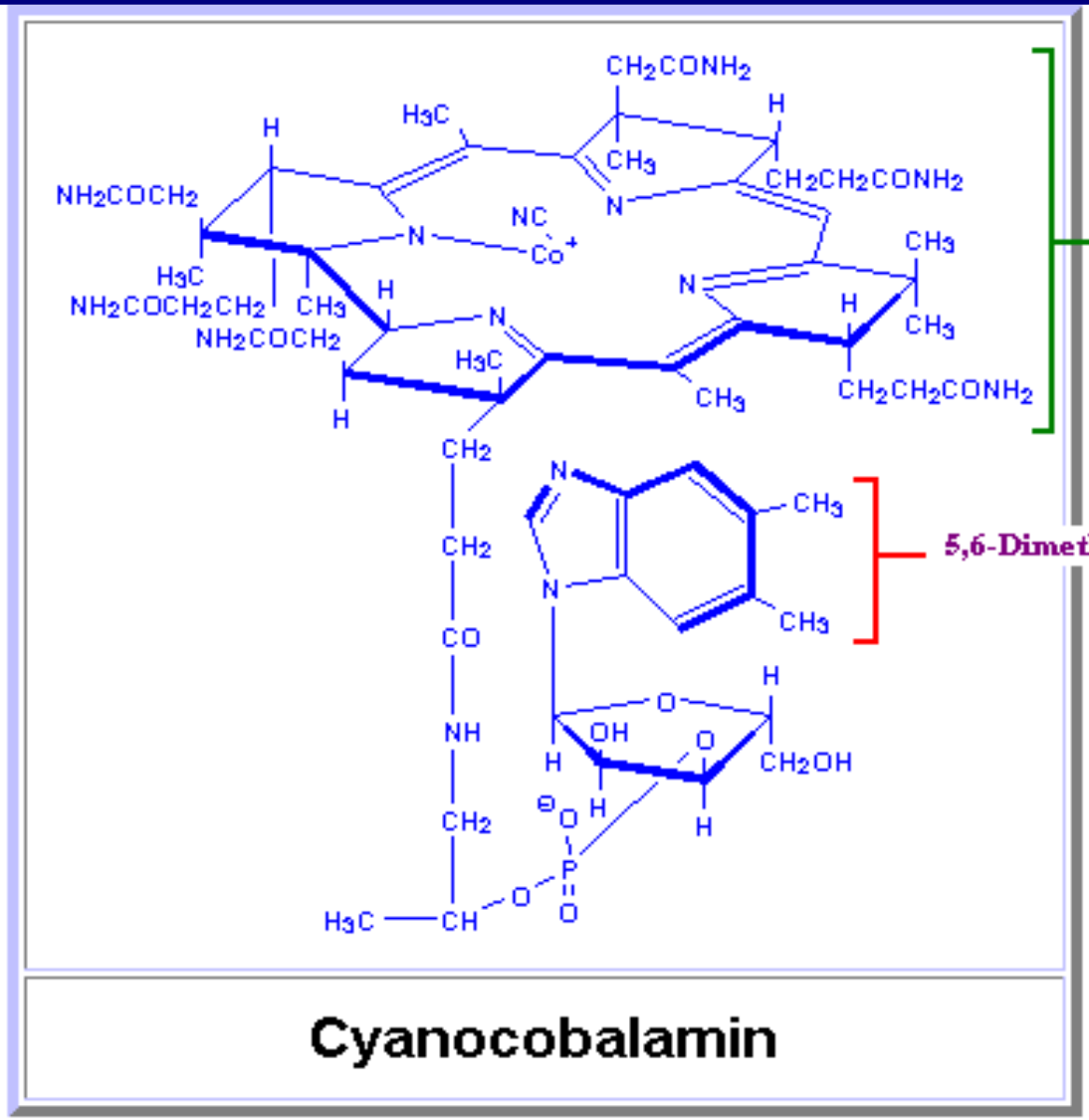
- Transamination
- Deaminetion
- Decarboxylation(α-amino acids)
- Glycogenolysis(glycogen phosphorylase)
- NAD+(Trp pathway)

Vitamine H (Biotin)

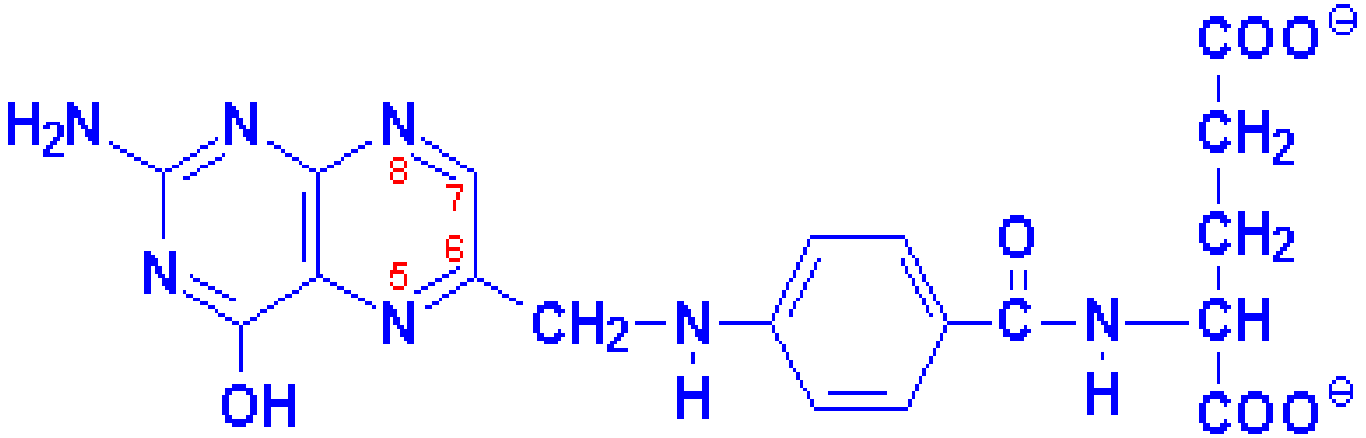


Biotin

Vitamine B_{12}



Folic acid

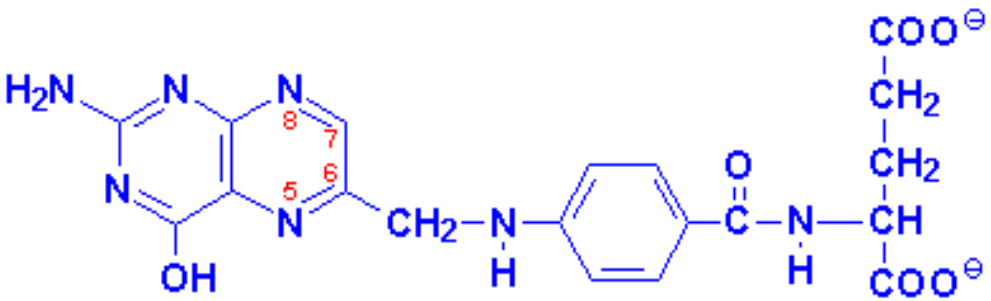


Folic Acid

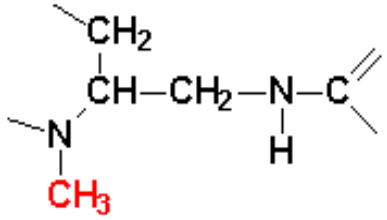
positions 7 & 8 carry hydrogens in dihydrofolate (DHF)

positions 5-8 carry hydrogens in tetrahydrofolate (THF)

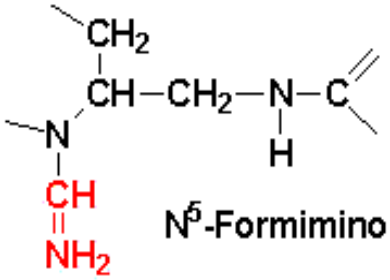
Folic acid



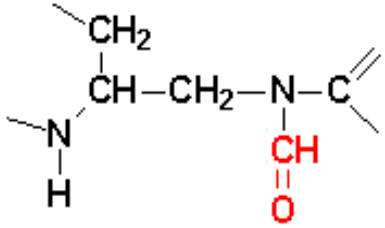
Tetrahydrofolate
(H_4folate)



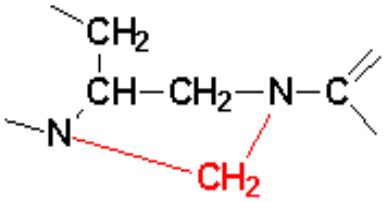
N^5-Methyl H_4folate



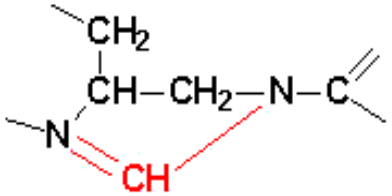
N^5-Formimino H_4folate



N^{10}-Formyl H_4folate



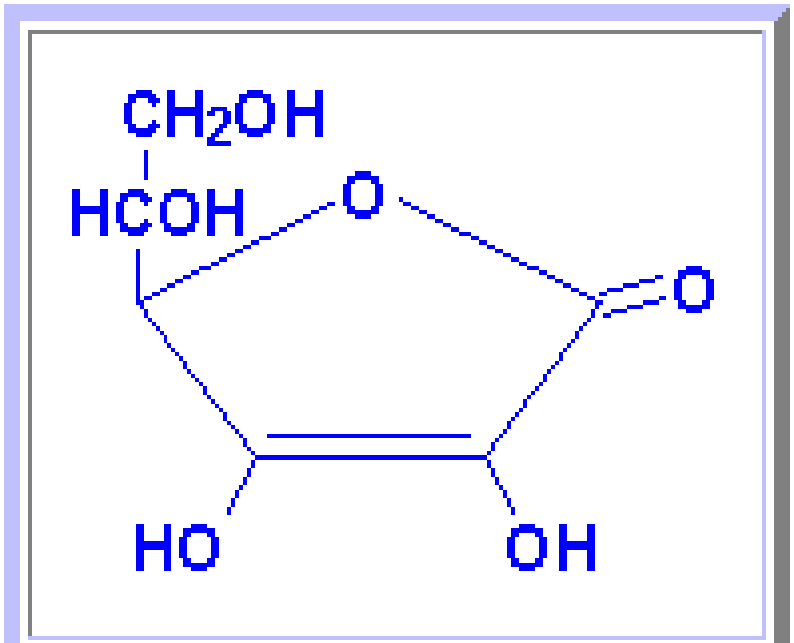
N^5,N^{10}-Methylene H_4folate



N^5,N^{10}-Methenyl H_4folate

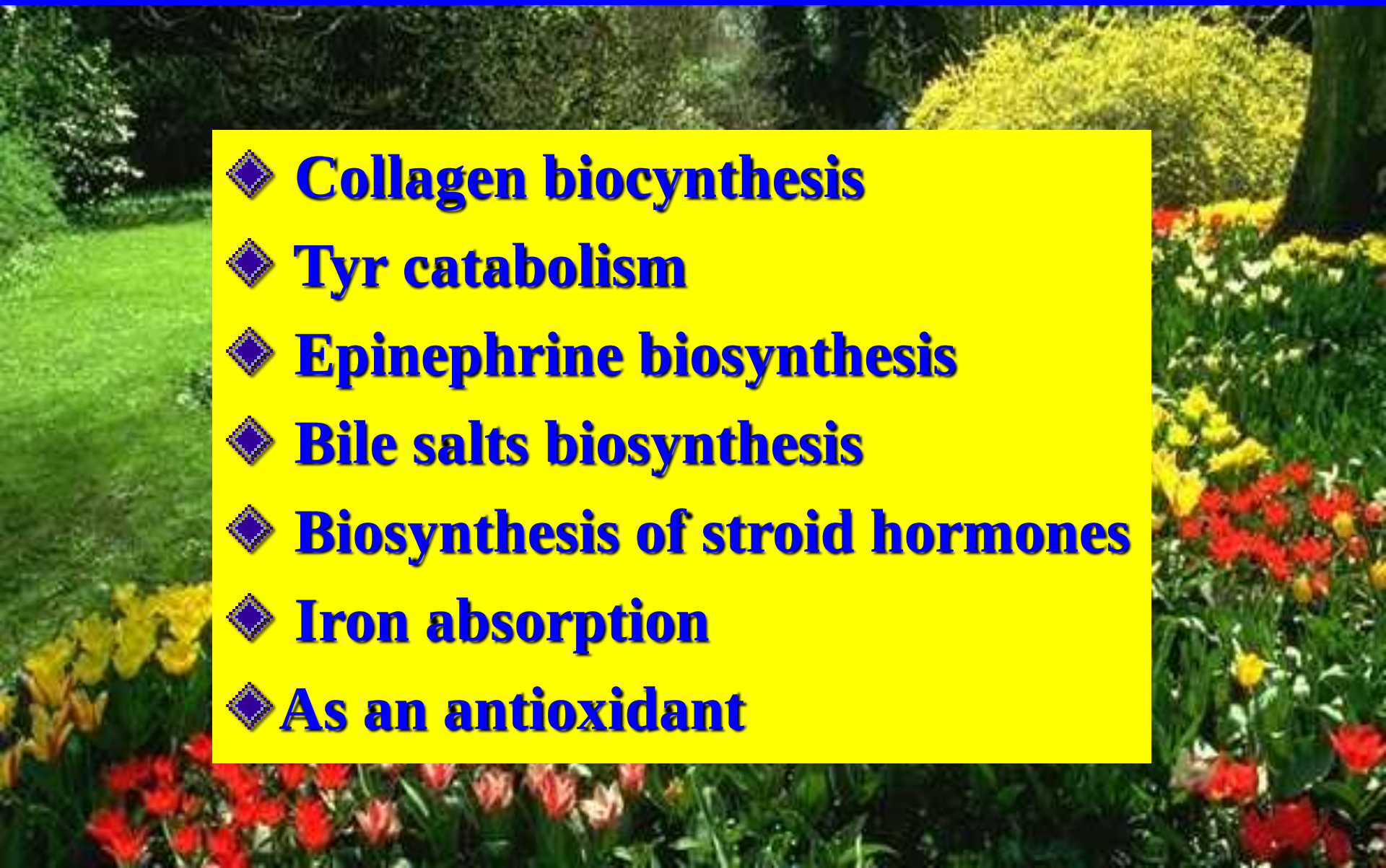
Vitamine C

Ascorbic Acid



vitamin C

Vitamine C



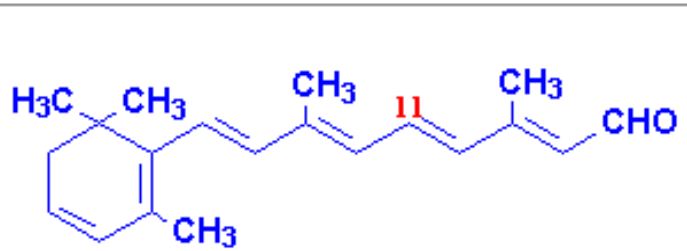
- Collagen biocynthesis
- Tyr catabolism
- Epinephrine biosynthesis
- Bile salts biosynthesis
- Biosynthesis of stroid hormones
- Iron absorption
- As an antioxidant


Fat-soluble Vitamins

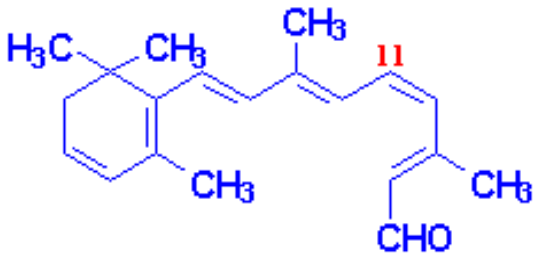
Vitamin A

Vitamin A

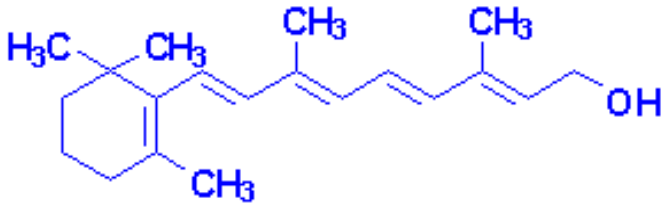
Vitamin A



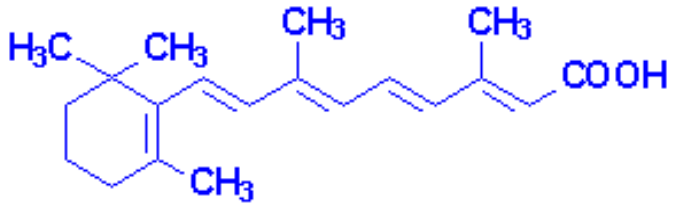
All-*trans*-retinal



11-*cis*-retinal

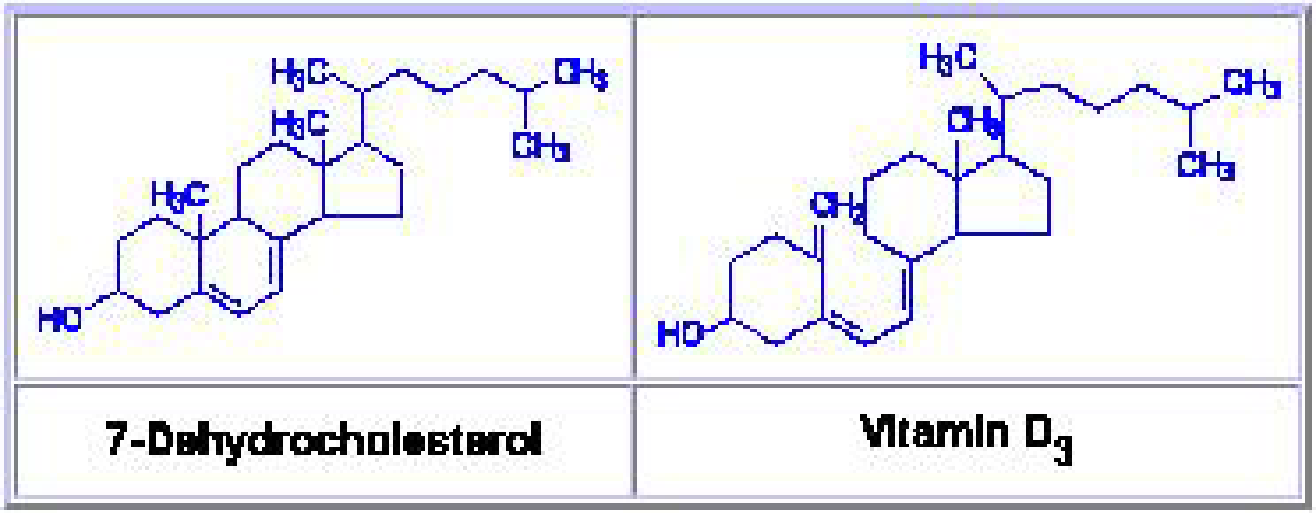


Retinol



Retinoic Acid

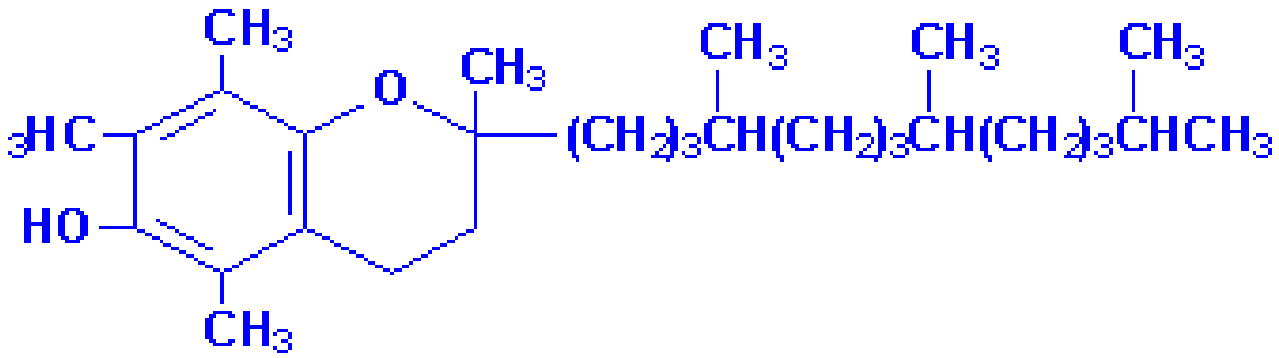
Vitamin D



7-Dehydrocholesterol	Vitamin D_3

Vitamin E

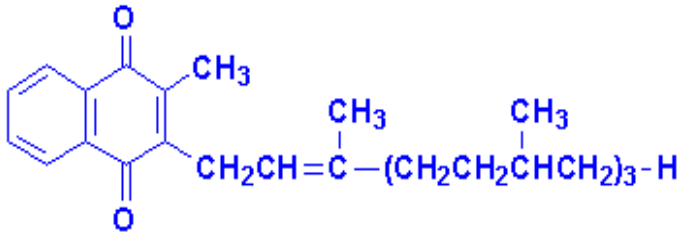
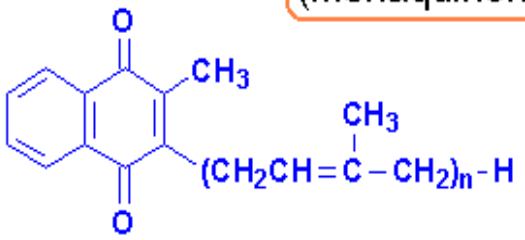
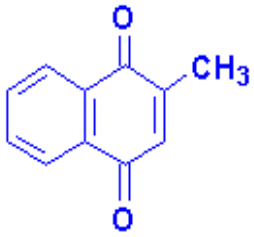
Vitamin E



α-Tocopherol

Vitamin K

Vitamin K

	(menaquinone) 	
Vitamin K_1 (phylloquinone)	**Vitamin K_2** "n" can be 6, 7 or 9 isoprenoid groups	**Vitamin K_3** menadione

Lipoic acid (Thioctic acid)